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Geographic Variation in Cooperative Colony Foundation in *Veromessor pergandei* (Hymenoptera: Formicidae)

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Abstract.—Veromessor pergandei queens are strictly haplometrotic at a site in California, while queens at sites in Arizona will found nests cooperatively. Possible explanations for this geographic difference include: higher success of brood raiding in Arizona, higher predation rates on young colonies in Arizona, and greater relatedness of colonies in Arizona.

INTRODUCTION

The desert seed-harvester ant, *Veromessor pergandei* (Mayr), founds colonies cooperatively in Arizona (Pollock and Rissing 1985); 68% of starting nests (n = 132) contained more than one queen. Starting colonies with multiple queens successfully brood raid and defeat singly founded colonies (Rissing and Pollock 1987). If proximity of starting nests affects the frequency of brood raiding, then a clumped distribution of young colonies would increase the frequency of brood raiding between young colonies. Thus spacing of starting nests could affect the success of single queen nests. Here I describe patterns of *V. pergandei* queen behavior and clumping at sites in the California and Arizona deserts. Differences between these sites may provide insight into factors regulating cooperative colony foundation by *V. pergandei* queens.

METHODS

The Arizona site was along the Tonopah Salome Highway 60 km west of Phoenix. Nests were censused in February 1987 along a 5 km roadside strip. Although the adjoining area was native Sonoran Desert habitat with *Larrea tridentata, Carnegia gigantea,* and *Prosopis velutina* as the dominant perennials, new nests were concentrated along the berm of a recently graded road. The California studies were conducted in February 1986 at the Boyd Deep Canyon Reserve, a part of the University of California Natural Reserve System. The dominant perennial plants were *Larrea tridentata, Hyptis emoryi,* and *Cercidium floridum.* The study site was a relatively homogeneous 3 ha area of alluvial fan habitat. At both sites, the starting colonies were visually located and censused by excavation. A typical *V. pergandei* starting nest is a semi-circular pile of soil or sand approximately 5 cm by 2 cm. These

diggings are most obvious a few days after a rainstorm, since the excavated soil will be darker than the background soil. Since *V. pergandei* is claustral, the oldest diggings will start to blend in with the background soil with each successive storm.

Results and Discussion

V. pergandei at Deep Canyon is strictly haplometrotic, colonies are founded by a single queen (N = 181), while 28 of the 98 Arizona nests had multiple foundresses ($\chi^2 = 43.6$, d.f. = 1, $p < 0.001$). Although the frequency of multiple queen starting nests in my Arizona site is not as high as the 90 of 132 nests with more than one queen reported by Pollock and Rissing (1985, Figure 2), it indicates that my excavation methods can detect the presence of multiple queens in starting nests. Queen tolerance for additional foundresses also varies at the two sites. Deep Canyon queens will fight when placed in the same vial, while I have never observed this behavior in queens collected from the Arizona site.

V. pergandei nests at Deep Canyon are initially clumped, then after the first workers emerge, the remaining nests are randomly spaced (Ryti and Case 1988). It is possible that some of these young colonies could have been destroyed through brood raiding (Rissing and Pollock 1987), or other factors, including: predation by long established conspecifics, predation by other ant species, or predation by spiders or rodents. Note that the spatial arrangement changing from clumped to random does not necessarily imply that there was selective attrition to clumps of starting colonies. Equal survivorship of the originally clumped starting nests would also produce randomly dispersed young colonies (Ryti and Case 1988). Newly founded nests are also clumped in Arizona ($n = 42$, $p < 0.001$, Rissing pers. comm.).

There are three potential selective mechanisms that may account for the geographical difference in the evolution of colony foundation. 1) Brood raiding affects young colony survivorship in Arizona and not in California. The frequency of brood raiding could be related to the spatial dispersion of nests when the first workers emerge. If Arizona colonies are clumped when workers emerge, then brood raiding could be a significant factor. The existing spacing data does not support this explanation, since both Deep Canyon and Arizona nests are initially clumped. However, colonies may be clumped in Arizona because of microhabitat selection. Pollock and Rissing (1985) noted that most queens found nests in wash bottoms. Arizona clumps may persist because of "better" physical conditions for brood rearing. Such microhabitat differences are not obvious between clump and non-clump areas at the Deep Canyon site. 2) Arizona single-queen nests are more vulnerable to predation. Colony predation rates may be higher in Arizona, and young colonies with more workers may survive predation episodes. 3) Cooperative colony foundation only occurs with queens that are closely related. Deep Canyon queens could be aggressive because outbreeding is relatively more common in California populations than in Arizona populations.

As a first step towards distinguishing between these possibilities, the spacing of foundress colonies in Arizona needs to be examined, especially after workers first emerge. These data, together with observations on the importance of predation, by ants and other species, and data on relatedness among colonies at these sites could explain the geographic differences in *V. pergandei* cooperative colony foundation.

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